

Appendix AA. Deepwater Horizon BOP Modifications Since Commissioning

Introduction

This appendix describes the modifications that the investigation team has identified since *Deepwater Horizon* blowout preventer (BOP) was commissioned and put into operation.

LMRP and BOP Stack Modifications

Table 1 lists the modifications that were made to the lower marine riser package (LMRP).

Table 1. List of BOP Maintenance-related Audit Findings.

Description	Date	Information Source	Impact On Functionality
ST lock modifications (also on BOP stack)	December 2002	Transocean maintenance reports	None
Change from retrievable to non-retrievable control pod.	January 2003	Transocean maintenance reports and Transocean BOP system modification report	LMRP must be retrieved to the surface to maintain pods.
New high-interflow shuttle valve (also on BOP stack)	November 2003	Transocean maintenance reports	None
Replacement of conduit valve package	August 2004	Transocean BOP system modification report and pod software revision history	LMRP accumulators are isolated on loss of pod hydraulic power.
Removal of fail safe panels on choke and kill valves (also on BOP stack)	August 2004	2005 BP rig audit and Transocean BOP system modification reports	Choke and kill valves will close on spring force only.
Replacement of lower annular preventer to stripping annular	July 2006	Transocean maintenance reports and Transocean BOP system modification reports	Reduced rated working pressure of lower annular preventer from 10,000 psi to 5,000 psi
Replacement of flex joint (used flex joint from Transocean <i>Deepwater Nautilus</i> with a 37.5 in. 'G' x 'H' crossover)	September 2008	Transocean BOP system modification reports and incident management team (IMT) responders	None

Table 2 lists the modifications that were made to the BOP stack.

Table 2. List of Modifications Made to the BOP Stack.

Description	Date	Information Source	Impact On Functionality
Change from lower variable bore ram (VBR) to test ram.	December 2004	BP correspondence and <i>Transocean BOP System Modification Report</i>	Improved BOP testing efficiency, but reduced VBR redundancy
ROV hot stab circuit modification	Unknown	IMT responders	None

Control System Modifications

There were a number of modifications made to the BOP control pods after 2001. Table 3 lists these modifications as they were reported in the Transocean maintenance reports.

Table 3. Modifications Made to the BOP Control Pods After 2001.

Description	Date	Information Source	Impact On Functionality
Pod subsea plate-mounted (SPM) valves - "All 1 in. valves have been changed out to upgrade 3/4 in. valve."	November 2001	Transocean maintenance reports	None determined to date
Pod flow meters - "Spare pod sent to Cameron for upgrade to install high-shock flow meters."	March 2002	Transocean maintenance reports	None determined to date
Pod regulators - "Install orifices in pod regulators to stop regulators oscillating."	May 2004	Transocean maintenance reports	None determined to date
Pod SEM - "Cameron installed software for upgrade."	June 2004	Transocean maintenance reports	None determined to date
Pod select - "Add a second pod select solenoid functioned by an existing pod select switch - to add double redundancy to each control pod."	November 2004	Transocean maintenance reports	None determined to date
Pod - "Replace all unused functions on pod with blind flanges. Possible failure points resulting in stack pull."	February 2005	Transocean maintenance reports	None determined to date

(continued)

Description	Date	Information Source	Impact On Functionality
Pilot regulator - "Replace pilot regulator with a better designed, more reliable regulator, regulator leaks. (Gilmore is a larger unit and will require a bracket to be fabricated for mounting.)"	September 2005	Transocean maintenance reports	None determined to date
Control panel - "Modification to Cameron control software to sound an alarm should a button stay pushed for more than 15 seconds. If a button is stuck and not detected it will lock up panel."	February 2006	Transocean maintenance reports	None determined to date
Automatic mode function (AMF) system - "Cameron will remove the SEM from the [multiplex] MUX section to replace the pie-connectors (customer provided) and to install the AMF/deadman modification kit."	January 2007	Transocean maintenance reports	None determined to date